



Implementing Technology to Drive Profitability

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Novozymes Technical Service

Today's discussion

1

Novozymes: biological solutions

2

Improving plant efficiency through data analytics and technical service

3

New liquefaction technologies drive plant profitability

Introducing nature's problem solvers

Sometimes
the greatest
answers in life
are found
in its smallest
components

Enzymes



Microorganisms



Catalyzing processes and
building up or breaking
down molecules



Cleaner clothes
with less consumption
of energy



Better nutrition
with less food waste



Green fuel
to reduce our
dependence on oil



Higher yields
and fewer pesticides

We also work with other proteins, biopolymers and related technologies



Biofuels Technical Service: As your implementation experts, we bring innovation to the industry

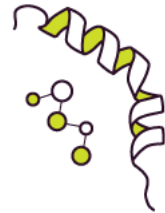
- The largest team in the industry
44 dedicated experts ready to help you
- Guided by in-depth knowledge
19 advanced degrees on the team
- Seasoned implementation experts
259 years of collective experience in the ethanol industry
- On the ground with you
12,000 hours spent on site each year
- Turning data in to solid business decisions for you
1 billion data points analyzed each year
- Unrivalled fermentation expertise
100,000 fermenters analyzed each year

Service areas focused on your needs

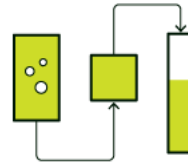
Laboratory



Products



Process



Data



Training



Data: Golden Batch

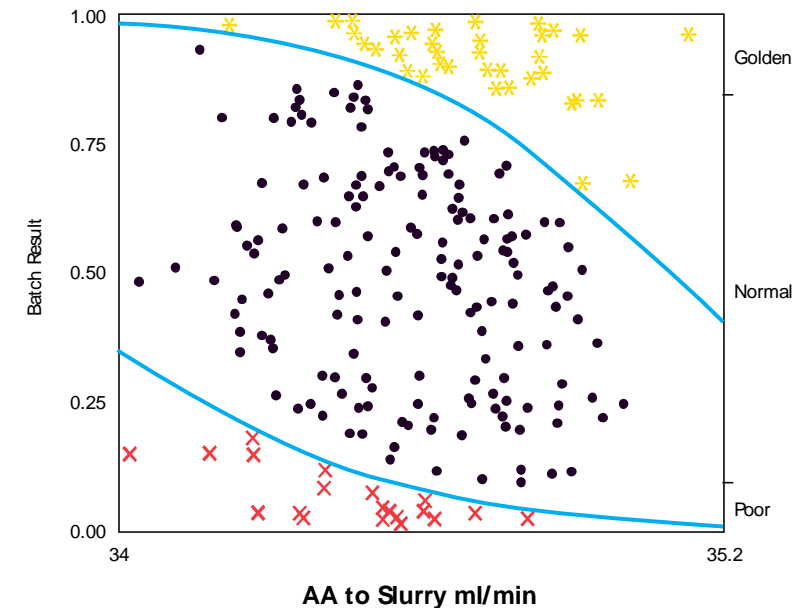
Golden Batch provides you with answers to these questions and more:

- What can I do to improve plant performance and cost efficiency at little to no extra input cost?
- How do I translate all my plant's performance data into actionable improvements?



How do you make every batch golden?

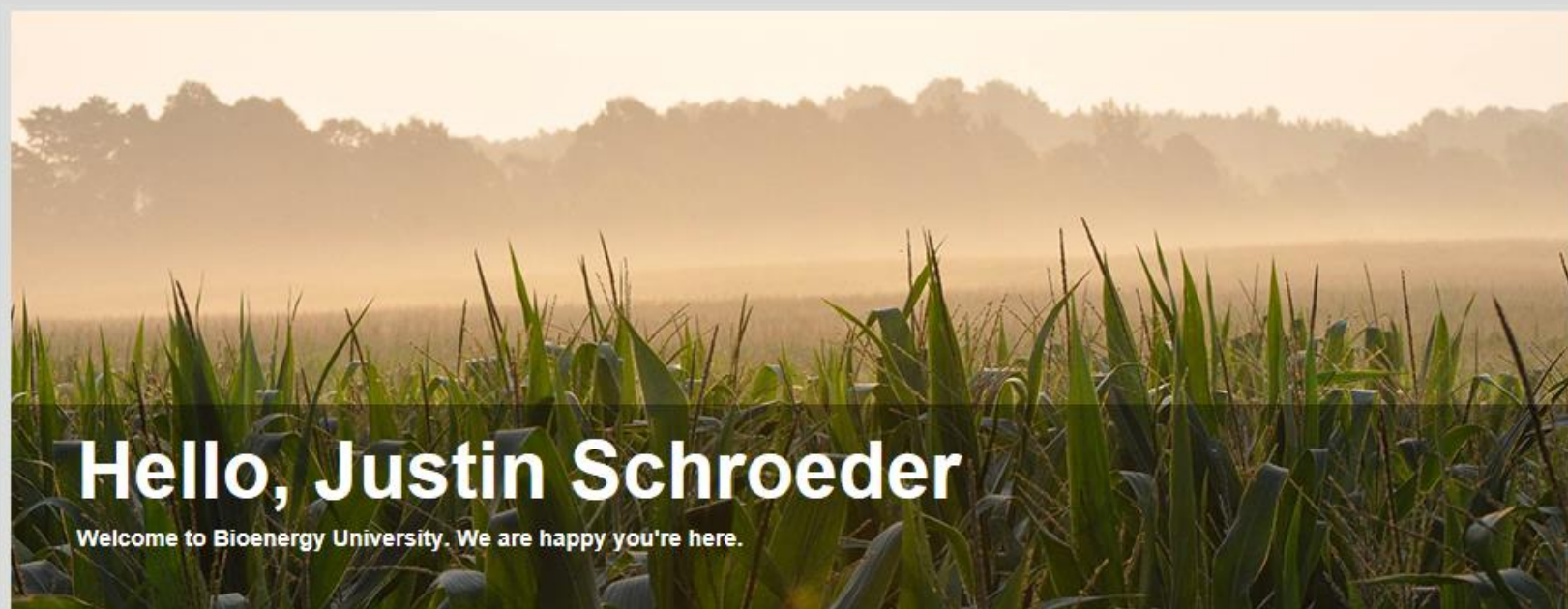
Logistic fit of batch result by AA to Slurry ml/min



Training: Bioenergy University

Bioenergy University provides access to a specialized collection of training courses for plant employees to continuously advance their skills and knowledge:

- Build deeper process and product understanding
- Increase awareness of plant processes and procedures
- Develop and refine plant best practices
- Improve process consistency



ONLINE TRAINING

[See courses you are enrolled in >](#)



VIDEOS

[Browse video resources >](#)



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ETHANOL CHALLENGE

[Ready to play? >](#)



INDUSTRY EXCELLENCE WORKSHOPS

[Coming Soon! >](#)

The **bioenergy winners**
of tomorrow will be those who
stay agile and keep **moving forward**

Keys to success

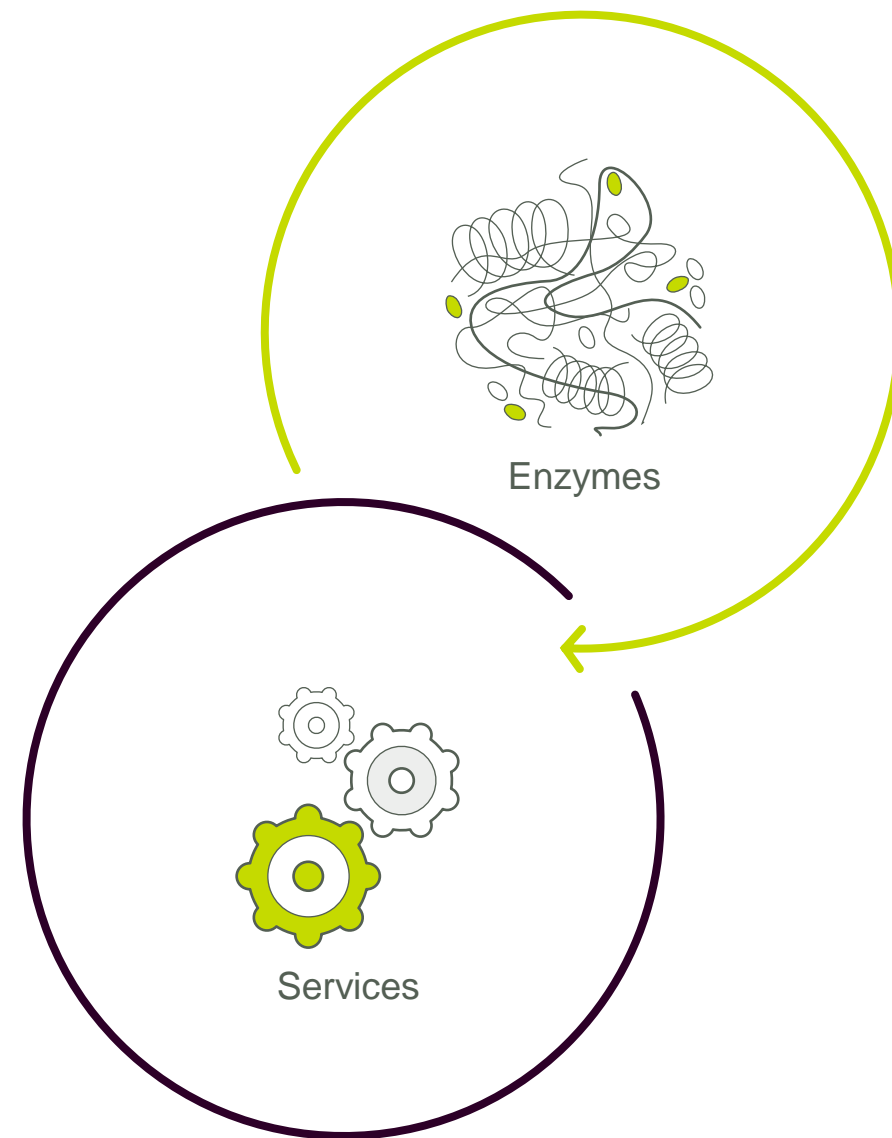
1. Increased production efficiency
2. Cost savings
3. Process consistency
4. Diversification with higher value streams



Novozymes' solutions are the small components which make a big difference when margins matter.

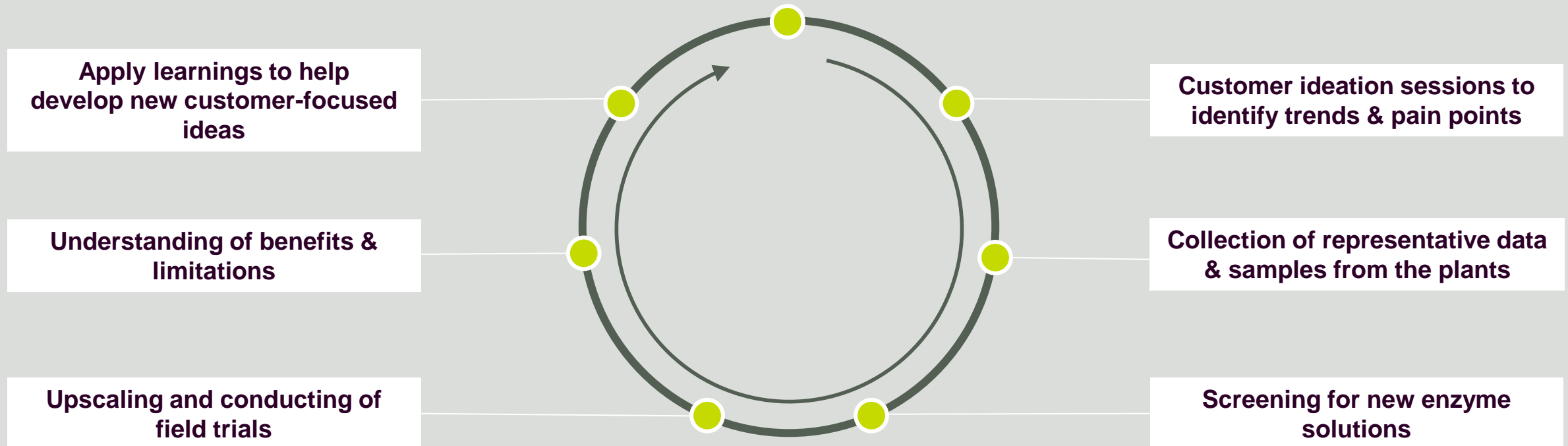
We have to have the broadest, highest-performing **toolbox** and **full value package** in the industry for all types of plants and market conditions.

Our technical service team stands by your side to innovate, implement solutions and bring you new value. Be it DDGS, yield enhancement or energy savings, our solutions keep you advancing.

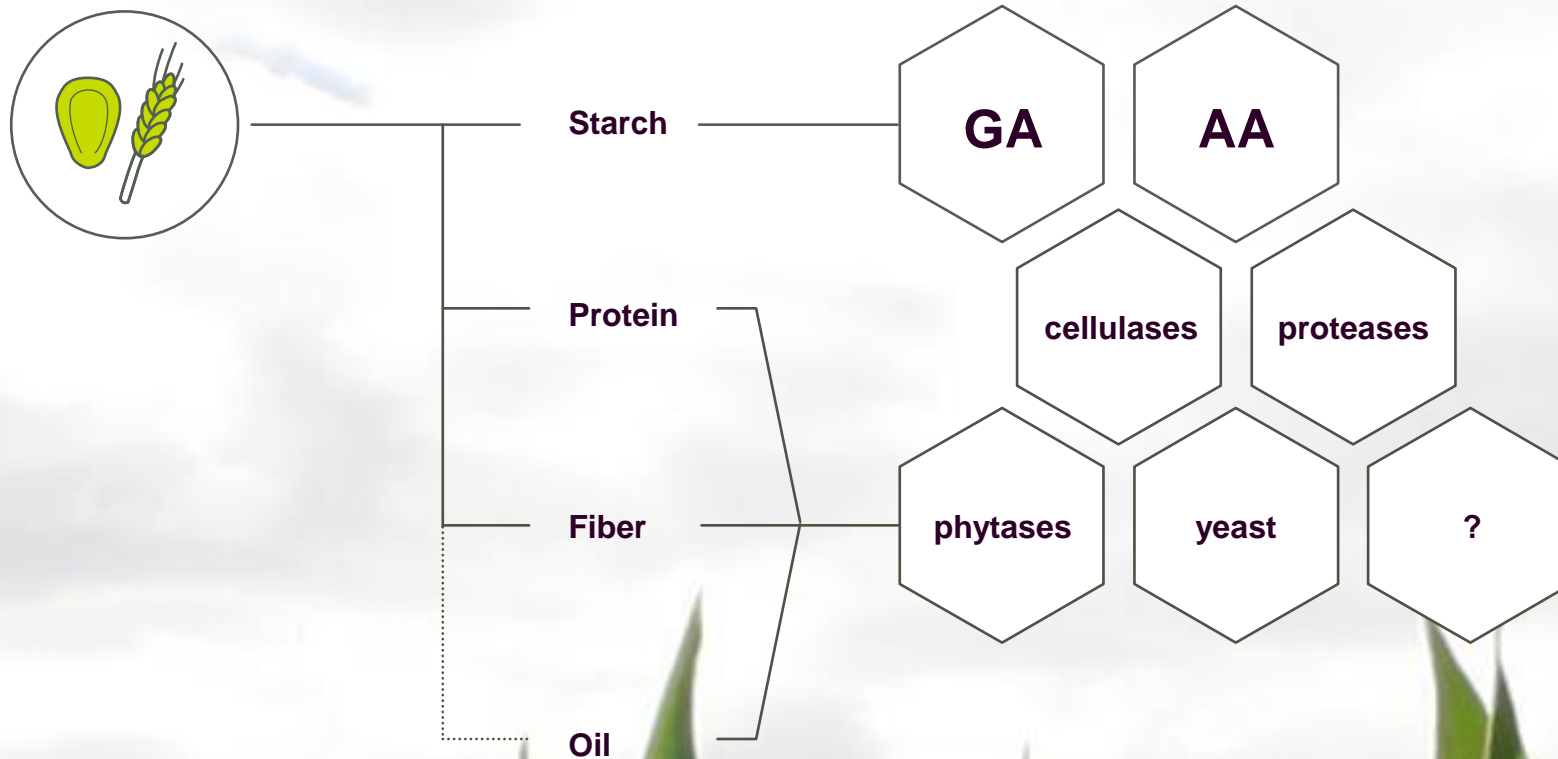


Novozymes Technical Service and Research & Development teams work collaboratively toward new, meaningful solutions

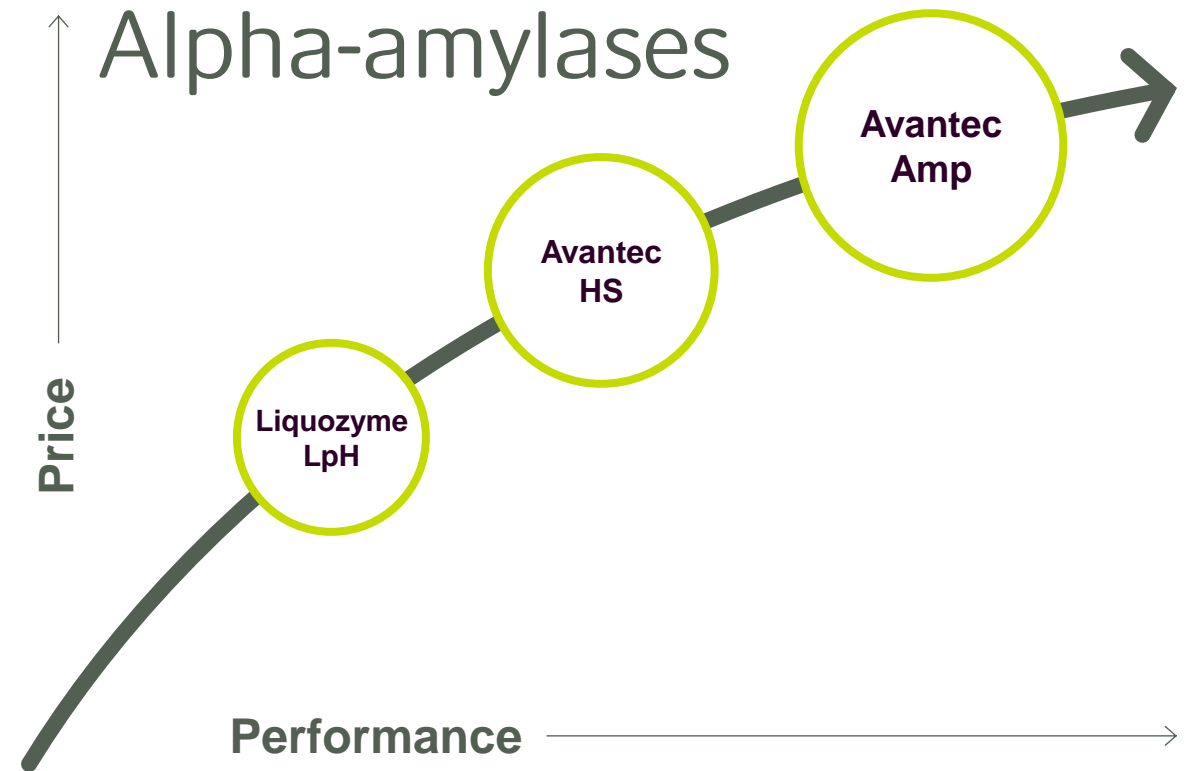
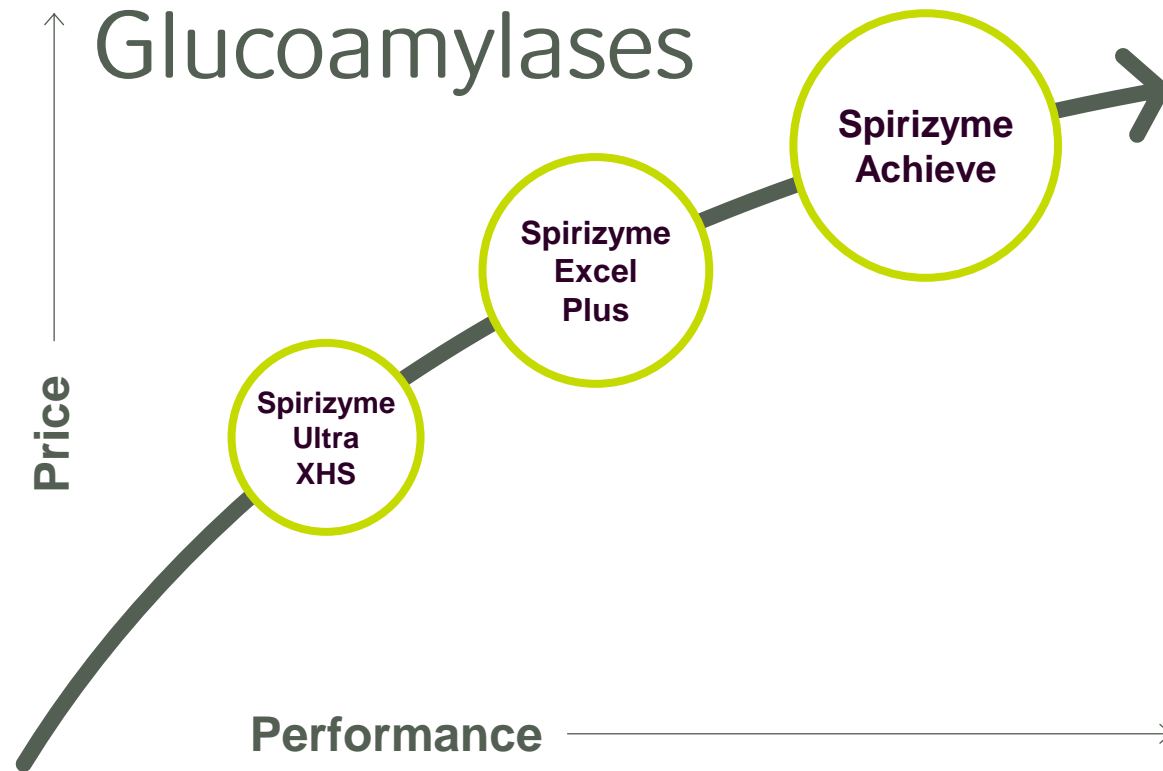
NEED: Industry needs to continuously innovate to remain competitive



Squeezing the last drop out of every kernel and market condition



A broad toolbox that helps you stay agile and flexible



Introducing Liquozyme LpH

A new low pH alpha-amylase



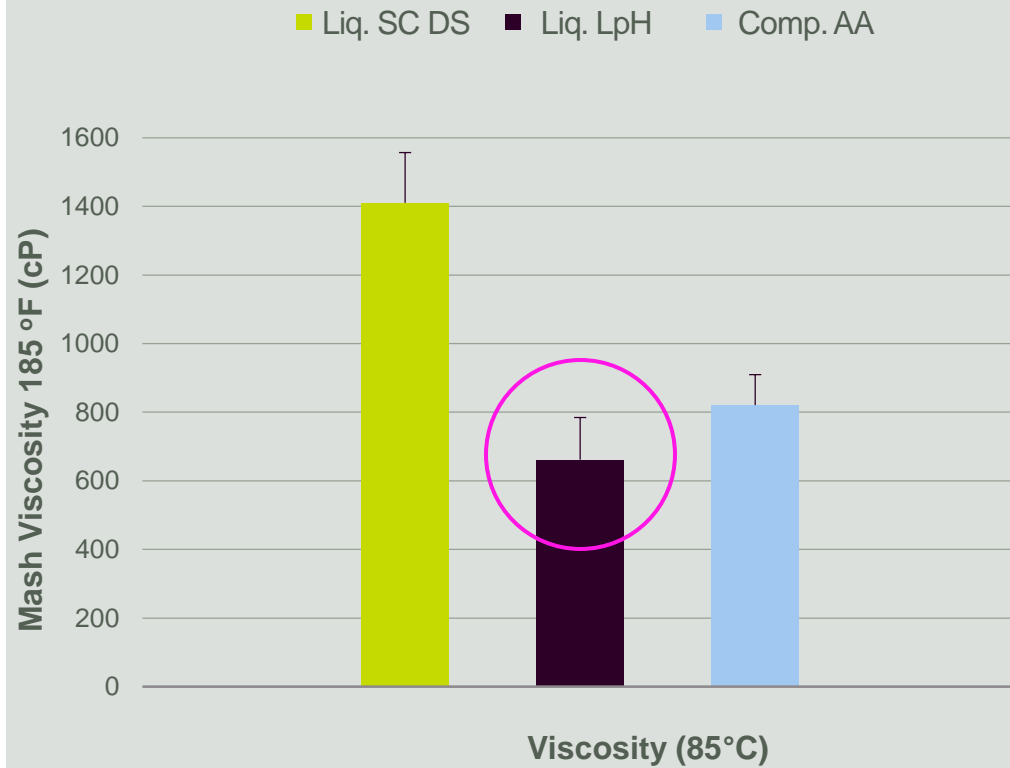
Benefits

- Superior viscosity reduction at low pH **ensures smooth operational performance**
- **Peace of mind** with **industry-proven** robust performance to insure against pH excursions
- Enables reduction or elimination of ammonia to **help reduce risk to your plant**
- Formulation and performance provide an **economical enzyme choice you can trust**

Liquozyme[®] LpH

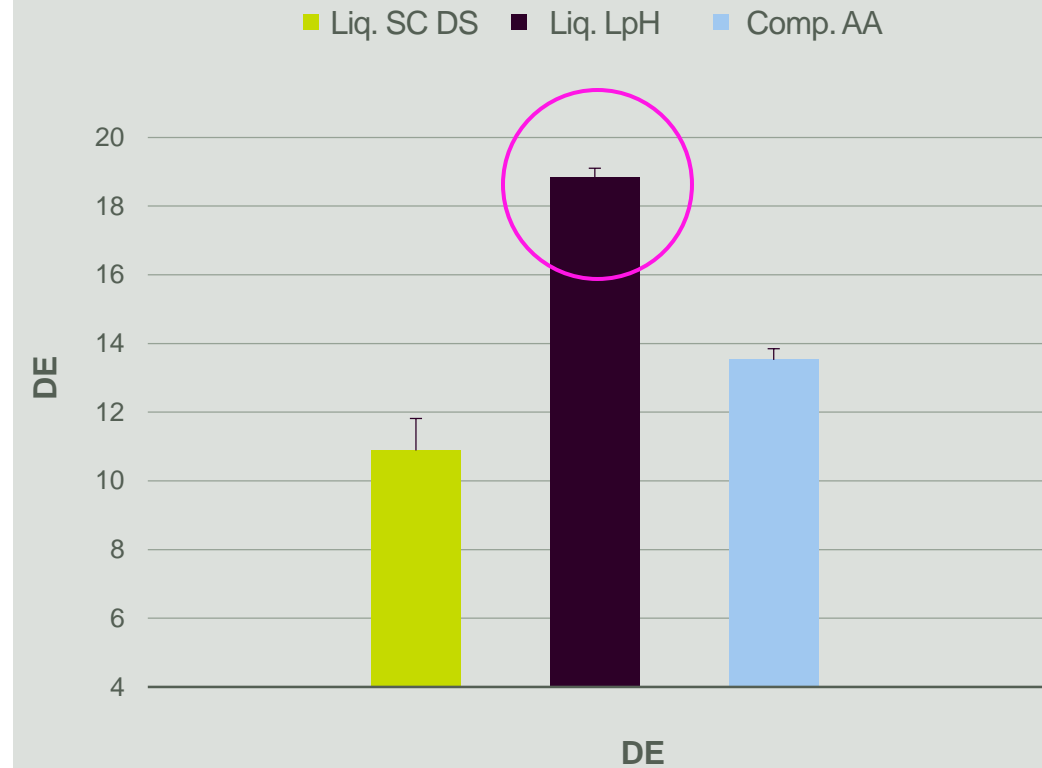
Eases and improves operational efficiency

Viscosity (185 °F, 150 min liquefaction)



All trials run at pH 5.2

Dextrose Equivalent (DE) (150 min liquefaction)



A full-page background image showing a male worker with a beard, wearing a red hard hat with a headlamp, a light-colored work shirt, and safety glasses. He is holding a large, full white bag, likely containing a liquefaction product. The setting is an industrial facility with metal structures and warm lighting.

Introducing

Avantec® Amp

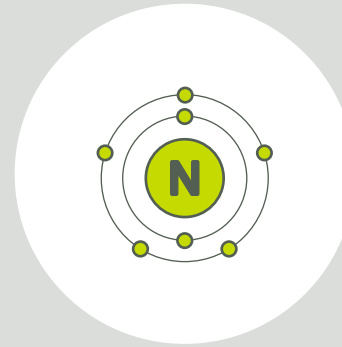
The industry's most advanced liquefaction product

Spotlight on Avantec® Amp: An new industry standard



**15% or
more corn +
oil yield**

**70-90%
less
nitrogen**



=

More net profits

MORE

- Faster, more consistent and robust fermentations +
- Increase ethanol yield +
- Safer work conditions and process simplicity +
- Capacity to run higher solids or increase throughput +

LESS

- Less process inputs of urea, ammonia, corn-oil surfactants
- Eliminate stand-alone protease storage, addition and cost
- Less storage and handling of chemicals
- Less complexity- simplify the recipe by eliminating process additions to reduce the risk of errors
- Less process upsets due to enhanced viscosity performance

Set a new standard:

Reduced spend on urea

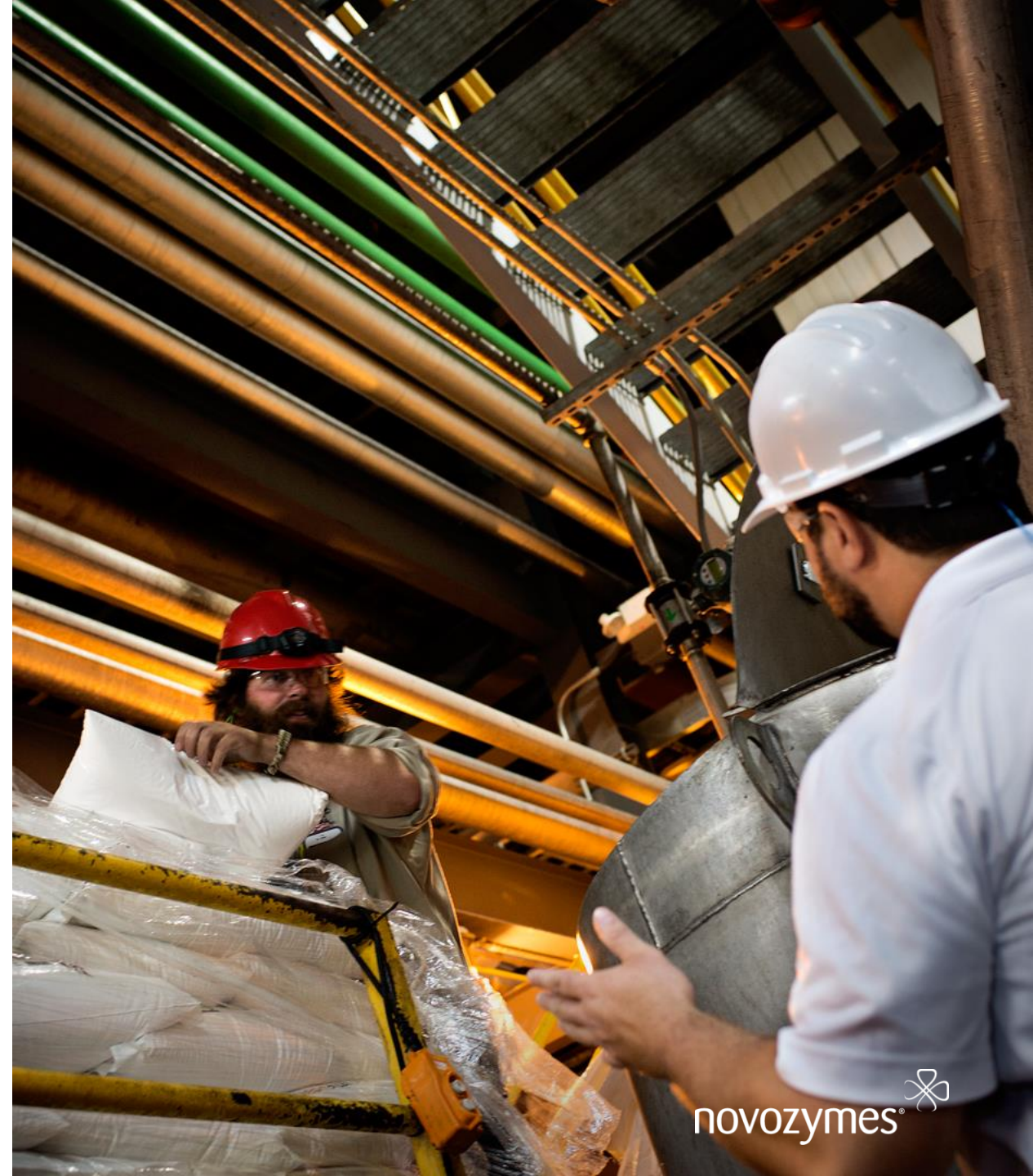
Typically more than

\$700,000/ year

for a 110 MGY plant

Calculation based on:

- Estimated reduction of 3,000 pounds urea per fermentor
- Reduction of 1,620 tons of urea per year at \$450/ton
- ***That's elimination of over 3,200 sacks per year, each with 1,000 pounds urea***



Set a new standard:

Amp up your fermentation health

Fermentations become much more uniform

as Avantec® Amp provides the yeast with a continuous nitrogen source of amino acids and peptides, and also achieves robust starch conversion. Avantec® Amp offers excellent viscosity reduction in cook.

Avantec Amp:

- Excellent reduction of viscosity of mash at a wide pH profile
- Much more uniform fermentations, due to consistent N feed and quality to yeast
- Lower glycerol profile

What it means for your plant

Gives you the choice to run at higher solids or higher run rates

Value for a 110 MGY plant:

1% ethanol yield ≈

\$250,000

net profit

1% throughput gain ≈

\$300,000

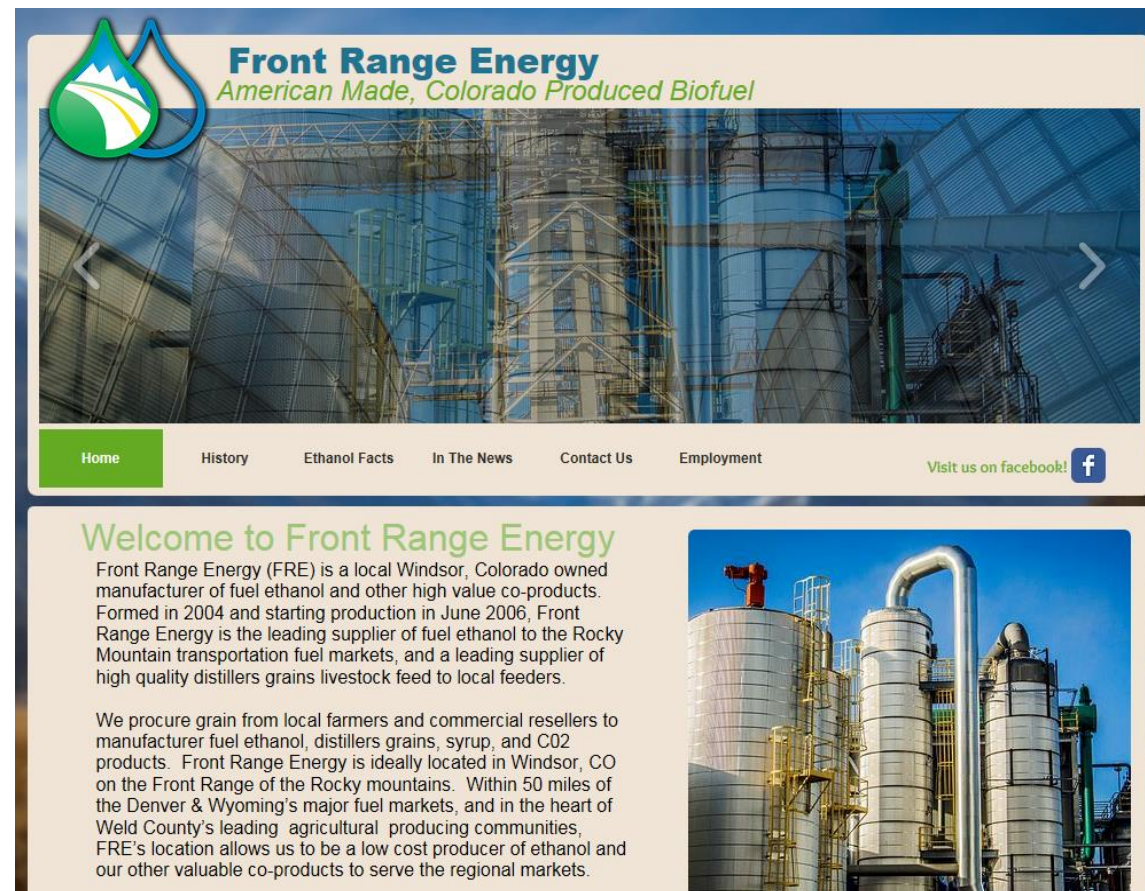
net profit

Set a new standard:

“provides generous value for ethanol plants to capture”

“Avantec® Amp provided us with significant increased production of corn oil, and also substantial reductions in fermentation ingredient inputs. This, coupled with ethanol yield improvements, provides generous value for ethanol plants to capture.”

Dan Sanders Jr, Vice President,
Front Range Energy, Windsor, Colorado



Committed to increasing profitability and creating impact for you

Together, we create **new value**. We deliver on **this promise** for all types of plants and market conditions

- Throughput, yield and energy **performance** to increase your margins
- Access to new, industry-leading **innovation** to keep you advancing
- Continuous **training** to keep your people safe and up-to-date
- **Data insight** and **benchmarking** for enhanced decision-making
- On-site **implementation taskforce** to help ensure results



